College of Computing

- Engineering Level Tactical Engagement Models
- Engineering Level Modeling of Threat Warning Systems
- Battlefield Visualization

Simulation at Georgia Tech

Research Institute and College
of Computing

Simulation

- Engineering and Tactical Engagement

  Models
- Engineering Level Modeling of Threat

  Warning Systems
- Battlefield Visualization

Tactical Engagement Models

- GTSIMS
  - Very High Fidelity - Signal Level Modeling of Blue/Red Systems
  - EO/IR Wavebands
  - Countermeasures and Jamming
  - Atmospheric Transmission
  - High Fidelity Backgrounds

TTECSS

- Tactical Threat Engagement Countermeasures Simulation System

  - Multispectral Simulation (EO-IR, RF)
  - Smoke and Obscurant Modeling
  - Countermeasures Modeling

Threat Warning Systems

- AAR44
- AAR47
- DIRCM
- ATIRCM/CMWS

Current Status

- Non-Realtime (100:1)
- Threat Engagement Matrix
- Evaluation of Alternatives
- Real Time Playback
- Bottlenecks - Scene Generation and Signal Level Models
- Improvements in Rendering

Test and Evaluation Future

- Virtual Test Ranges
- Hardware in the Loop (HITL)
- Software Test Planning
- High Fidelity, Real Time Simulation

GTSIMS/GTVISIT

Signature Modeling Techniques for Terrain Backgrounds

- Infrared Emission
- Characterize materials as first principles (GTSIG)background
- Execute GTSIG for desired cases to get temperature predictions
- Execute GTVISIT/MODELIR to produce in-band radiance map

- Reflected Solar
- Assign reflectances to materials
- Input in-band direct and diffuse solar irrandance, surface normals

Current Background Models for GTSIMS

- Kuwait desert scene
- Hills and trees scene (based on subset of Ft. Hunter Liggett)
- Iran mountain desert scene
- Urban scene (Atlanta area)
- Ft. Hunter Liggett extended scene (8 km x 8 km)
- Synthetic ocean background
- White Sands Missile Range cable car facility (in process)

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Problem: Large, Complex Terrain Databases must be Rendered in Real Time to support T & E.

- High Fidelity Terrain and Image Databases are becoming Available for Test Sites
- 1 Meter Image Resolution may be Acquired using Aerial Photography
- 1-2 Meter Elevation Data may be Acquired by Stereo Extraction
- Databases of 300 to 500 Gigabytes will not be uncommon

Current Hardware Rendering Capability

- 300,000 Textured Polygons / sec (10,000 at 30 frames / sec)
  - Silicon Graphics
  - Evans and Sutherland
- Phototexture Rendering of Terrain and Objects
- 4-16 Megabytes of Texture Memory
- RGBA “True Color”

Techniques That Address Hardware Limitations

- Multiple Resolution Databases
- Quadtree Database Structure
- Advanced Culling Techniques
- Dual Paging Strategy
  - Memory to Texture Memory
  - Disk to Memory
- Level of Detail Management
- Distributed Multi-Processing and Parallel Computing

Advanced Culling Techniques

- Efficient View Pyramid Intersections
- Retain Paging Buffer of Last Accessed Nodes

Dual Paging Strategy

- Immediate Memory Paging of Terrain and Texture
- Look Ahead Strategy to bring in New Texture and Terrain Nodes
- Server Implementation for Terrain and Image Texture
- API: Terrain, Texture, and Feature Servers

Quadtree Data Structure

- Efficient Organization for Complete Freedom of Movement
- Dynamic Quadtree Implemented to Accommodate Paging
- Complexity of Terrain Stored for Each Subnode
- High Resolution Insets Accommodated
- LOD of Terrain and Texture Dependent on Distance and

Multi-Resolution Databases

- Only Render Nearest Data at Highest Resolution
- Render Far Away Areas at Low Resolution (Mimic Human Vision)
- Pre-calculation Avoids Computation Load
- Terrain and Image Texture may be Rendered at Different Resolutions

Object Level of Detail Management

- Use of Varying Complexity Models
- Use of Multi-Resolution Photo-Texture
- Distance Based Decision Rule

Distributed Multi-Processing and Parallel Computation

- Paging Implemented as Multi-processor
- ARL Servers Utilize Parallel Processing
- DIS Integration Underway
- MODSAF Forces Generation

Virtual GIS

- This GIS of the Future

- Combination of GIS/RS/Visualization

The Reality of Virtual GIS

- Natural Interface for Humans in a 3D World
- Direct Inclusion of Visibility Constraints
- Total Immersion into Geographic Area
- Instantaneous View and Query in 3D
- Direct Query of all GIS and Attribute Data
- 2D Analysis is a Subset

VGIS System Description

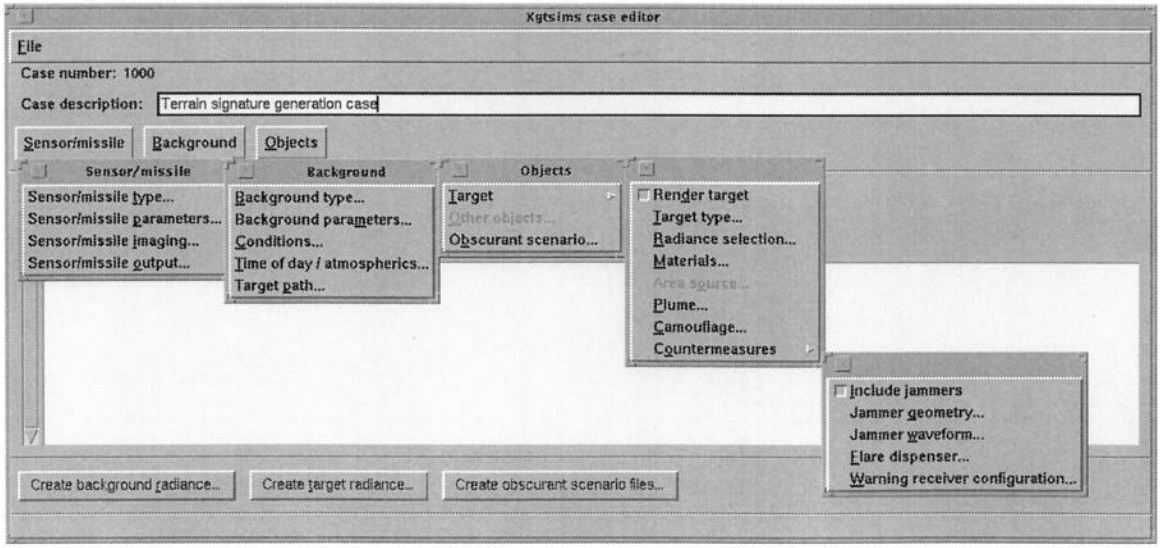
- VGIS provides for visualization of spatial data:
  - Elevation data
  - Terrain Imagery data
  - Traditional GIS data
  - Military Units and Control Measures
- VGIS provides for real-time, interactive visualization
  - Appropriate Level of Detail Selection
  - View Frustrum Culling
  - Data Paging

VGIS Visualization Features

- Two Interfaces: Immersive and workstation
- Navigation: 6 DOF, overview map, jumping, attaching to vehicles
- Query: Objects, GIS data
- Rendering Options: Phototextures, Gouraud shaded, atmospheric effects
- Military Needs: Line of sight, field of view, symbolization for units and control measures

The GTSIMS Simulation Environment

- An environment that makes 3D scene and target models available for use by IR sensor simulations such as DISAMS
- A rich database of target models, scene models, and IRCM models
- Interfaced through X-windows GUI called XGTSIMS



XGTSIMS Case Editor